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THE THREE PERSPECTIVES OF INTEGRATING ASSESSMENT AND INSTRUCTION IN THE LEARNING OF SCHOOL MATHEMATICS

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Abstract
This paper discusses three different but related perspectives of integrating assessment and instruction from a theoretical perspective. Each of these perspectives is discussed based on the literature to highlight how they may be viewed in the notion of assessment as an integral part of assessment. The theoretical orientations considered here are concerned with the role of assessment in supporting teaching, which is also commonly known as formative type of assessment. The paper further indicates potential benefits in the learning of mathematics with respect to each of the three perspectives. The potential benefits for the last perspective have been emphasised in detail in cognisance to their direct relevance to the learning process.

Key words: Assessment, Integration of Assessment and Instruction, Authentic assessment, Formative assessment

In this paper, assessment is used in the manner that Black and Wiliam (1998, p 2) referred to as "those activities undertaken by the teacher and by the students in assessing themselves, which provide information to be used as feedback to modify the teaching and learning activities in which they are engaged". This role of assessment is that in which it is used to find out the learning needs of the students and how they can be addressed to enhance learning. It is understood that there are several ways in which assessment may be considered an integral part of teaching.

One such a perspective is that of the matching of what is taught to what is assessed and assessing all aspects of the curriculum, including those that cannot be assessed by paper-and-pencil techniques. By doing this matching, it may be perceived as one way of ensuring that assessment is seen as an integral part of teaching. The main focus of this perspective is about the nature of students' mathematical knowledge and the need for it to be ascertained in forms that display all its characteristics. As stated by Masters and Doig (1992, p 253):

> If methods of assessment are to be more consistent with our current understanding of mathematics learning, then new approaches to assessment and new assessment tools will be required. These approaches and tools will have an overriding objective: to provide a better understanding of mathematics as it is experienced.

Under this pespective, all facets of the curriculum would be aimed at in assessment procedures. Such assessments would be seen to serve as a means of achieving the goals of the curriculum in a holistic manner. Therefore, assessment and instruction would be viewed to be integrated to produce the 'whole' curriculum that is desired.

The second perspective is that in which assessment is conducted to find out the effectiveness of the teaching process and the curriculum. In other words, the focus of assement would be to evaluate how teaching is performed and whether the specified curriculum is adhered to. As stated by Stobart and Gipps (1997, p 18) teachers might assess students for the purpose of obtaining feedback to the teacher "to aid the curriculum / lesson planning". Assessment of this nature has been referred to as "assessing for diagnosis of teaching" by Harris and Bell (1994, p 91). Consequently, the focus of the assessment feedback would not be much on the individual student but rather on the teaching and the curriculum. The information obtained from such assessments would then be used as feedback to the teacher on their teaching effectiveness (Grouws and Meier, 1992, p 92). Such feedback may be used to answer questions about the teaching process such as 'Was the task too advanced for the level of abilities of the students?', 'Was the marking guide suitable for this particular class?', 'Could another method been more effective?' and so on. Answers to questions of this nature would inform the teaching process as well as the curriculum, in that they serve as the starting points of an evaluation process, as has been pointed out by these authors. Here, the teacher would be engaged in examining the teaching process by considering those aspects of the information obtained from the assessments to learn about its strengths and weaknesses. It will be where students' responses to instructional activities would be analysed to identify the impact of the different facets of the teaching process. The analysis and interpretations would then be incorporated in planning for future lessons, that may be of the same students or for other groups of students that could be taught the same

mathematics content. This process of assessing students for obtaining feedback about the teaching effectiveness should be expected to continue throughout the programme since the teacher's main aim would be to find ways of teaching that have a positive impact on learning. As a result, assessment information is incorporated in teaching decisions that are focused on improving the teaching process. This process then may be perceived as integrating assessment and instruction.

The third and last perspective of integrating assessment and instruction is whereby teaching and assessment are intertwined in an effort to use assessment formatively. The main factor that distinguishes this perspective from the other two perspectives sicussed above, is that assessment is focused on the learning process and progress made by individual students toghether with what is required to aid the progress. Under this perspective of integration of assessment and instruction the aim is to find out "[students'] mathematical thinking and how to use that knowledge as the basis for instructional decisions for both individual students and the class as a whole", as stated by Chambers (1993, p 18). Therefore, assessment feedback would be detailed enough to indicate to the student the nature of the mathematical understanding they have reached and how it can be improved (Stobart and Gipps, 1997; Wiliam, 1999b). For such feedback to be effective, it needs to be based on assessment of students' mathematical knowledge and those instructional advances that may be employed to shape the students' thinking towards improving the learning process. Teaching and learning that is based on assessment feedback of this nature is percieved by many to have the potential to improve learning. As noted by Grouws and Meier (1992) there is research evidence that significant learning occurs when teachers continually assess student knowledge and thinking, and emphasise knowledge and problem solution in their teaching practices. On the other hand, assessments which are used to give students valid and reliable judgements about their work do not necessarily result in improvement in the learning process (Stobart and Gipps, 1997). This observation seems to be in agreement with the argument that students' thinking and knowledge needs to be examined and be used in instructional advances to aid the learning process, rather than being judged as it is often the case.

Torrance and Pryor (1998, p 131) suggest that in this perspective, assessment is intended to generate information about students' knowledge and understanding while at the same time contributing to the process of creating that understanding. Assessment is used to generate information about students in a detailed manner to be acted upon by the student and the teacher, with instruction being used hand-in-hand to create understanding. This kind of working is advocated by Fraivillig et al (1999) for advancing children's mathematical thinking. They identified instructional elements, which are about assessing the learning process and progress, its deficiencies and then providing appropriate assistance to support and increase understanding. A focus of assessment in learning is intended to assist teachers to learn students' mathematical thinking and to use the knowledge as an integral part of the teaching practice is reported by Nagasaki and Becker (1993, p 42) for Japanese classroom where teaching is directed towards using different ways of assessing students' thinking in order to raise the level of the students' understanding in the class as a whole. Here, teaching is often adjusted as a result of teachers' observations of students (a) to see how well the students understand their task (b) to select which response(s) will be presented to the whole class (c) to enhance the quality of discussion (d) to pay attention to the students' individual needs. Subsequently, teaching is adjusted based on the teacher's assessment of students as the lesson progresses. Here, assessment is performed as an integral part of teaching, not as a separate entity.

Potential benefits of integrating assessment and instruction

All the three perspectives of integrating assessment and instruction have potential benefits for the learning of mathematics. The first perspective of matching the taught content including those components of the curriculum which can not be assessed through the paper-and-pencil techniques, commonly viewed as as the formal mode, has great potential for enhancing learning. By such an inclusion, all components would be viewed as important and thus minimising the tendency of teaching following the assessment syllubii but rather ensuring that the teaching syllabii are are used as intended by the curruculum. Here, teachers would not be in aposition to identify certain concepts of the syllabus that have never been assessed in the past. There would be no way of guessing what would be assessed and what would not, and as aresult, learners would not be disadvanged by not being exposed to certain parts of the teaching syllabus. This in itself is very critical because the teaching syllabus is designed with specific aims and objectives meant to achieve an all round development of all students as stated in the new junior secondary mathematics syllabus (Republic of Botswana, nd) but not just those bound to pass the final mathematics examinations.

However, the matching of the taught content, including those that cannot be assessed throught the pencil-and-paper mode in the assessment procedures may not gaurantee improvement in learning. It is therefore, reasonable to consider the potential benefits of the second perspective of integrating assessment and instruction. In a study

by Bell and Cowie (1999) on clarifying (i) what it is that teachers do and think during formative assessment activities and (ii) the purposes for which they do formative assessment, it was revealed that two forms "Planned" and "Interactive" existed. The former form was perceived to serve the purpose of informing the teaching and relatively found easy to practise than the latter, which was directed towards the learning of individual students. In some sense it is a good thing that teachers are capable of finding out how their teaching impacts on learning since this can lead to improved practice. Although this is would be a real benefit in an education system, it leaves much to be done towards enhancing learning.

The third perspective of integrating assessment and instruction provides the needed platform towards closing the gap between instruction and learning since it brings together the teacher and students to be both responsible for learning. It has been established by Black, et al. (2002) that this requires "a learning environment has to be 'engineered' to involve pupils more actively in the tasks. The emphasis has to be on the pupils doing the thinking and making that thinking public'. Feedback under this perspective must be explicit for students to know what is required and what steps they need to take to understand the concepts being studied. This perspective of assessment makes use of the cognitive development of students as they engage in mathematical activities, to promote meaningful learning. It is guided by Ausubel's theory of meaningful learning, described as "a process through which new knowledge was absorbed by connecting it to some existing relevant aspect of the individual's knowledge structure." (Orton, 1992, p 155). The key point being the 'connection' to the individuals' existing knowledge structure, particularly before making their understanding public. It is suggested that, it is ultimately the individual student who makes or constructs the knowledge while the teacher facilitates the learning process by provision of forms of learning that stimulate thought and mental activity (Orton, 1994, p 38). The existence of the knowledge structure also points to the importance and need for ascertaining students' understanding if teachers are to identify and provide feedback for appropriate instructional activities. Furthermore, this perspective of integrating assessment and instruction is not based on any particular mode of assessing, for instance, formal or informal. All that matters, according to Driscoll (1995, p 17), is that students' mathematical thinking or evidence of it is 'unpacked' and incorporated into a learning environment for improved educational outcomes to be achieved.

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